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THE MOUND OF *POGONOMYRMEX BADIUS LATRL.* AND ITS RELATION TO THE BREEDING HABITS OF THE SPECIES.

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Even casual observers, visiting the suburbs of Augusta, Ga., are sure to notice this ant ; not merely because of its large size, but on account of its conspicuous mounds, which are scattered, in open places, on all the vacant highlands. A somewhat dry, sandy soil seems best suited for its development ; for, although the mounds are numerous on the divide, both along the roadside and in open patches in the woods ; yet, they are practically absent from the low, damp flood-plain. The conspicuousness of each mound is not due to its height, for each is only a few inches high ; but to its large, barren surface. Some of the mounds are as much as five feet in diameter, and many have a major axis of three feet. The area of the mound seems to be a function of the size of the colony. I say size rather than age of the colony ; because an old, but weak, colony will often have a smaller mound than a much younger colony that has a large population. This condition of affairs is due to the habit of occasionally abandoning its old mound and excavating a new one. If the migration occurs when the colony is small, even though it is old, the area of the mound will be small. In small mounds the shape is often subcircular ; but in larger mounds the shape departs much from that of a circle (Figs. 1-8). This mound is composed partly of materials excavated in forming and enlarging the burrows and partly of small pebbles and other coarse materials collected from the surrounding surface of the ground. All sizes of workers participate in making the mound.

The number of openings into the nest varies from one to several. This is true not only of different nests, but of the same nest at different times. If an opening to a nest is closed with small particles, by some agency foreign to the nest, the ants that may be on the outside at the time act, for a time, as though they

were confused; then they begin to remove the obstruction. In the meanwhile, the ants in the nest have been tunneling from within. Usually the ants from within are the first to penetrate the obstruction. Occasionally the ants on the outside are the first to make a breach. In one case observed by me, the ants on the outside took no part whatever in removing the obstruction until the ants in the nest had made an opening. When the nest opening is closed with anything which is not too large for several ants acting conjointly to remove, several will coöperate in removing it; otherwise a new opening is made. I have seen as many as five ants acting conjointly in removing an obstruction.

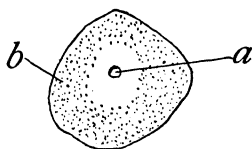


FIG. 1.

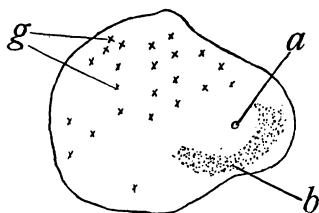


FIG. 2.

FIG. 1. Mound of *P. badius*, surface view. *a*, entrance; *b*, débris, mostly plant matter, from the nest. There were a few pebbles scattered over the mound. The nest contained workers of all sizes and several females. Greatest length, 17 in.; greatest width, 14 in.

FIG. 2. Mound of *P. badius*, surface view. *a*, entrance; *b*, débris, mostly plant matter, from the nest; *g*, stalks of green grass. The top is well covered with pebbles. Greatest length, 24 in.; greatest width, 20 in.

The statements in the preceeding paragraph were established by several experiments similar to the following: March 28, 1908, 5 P. M. — Numerous workers are on the outside of the nest. I fill the opening with sand and small pebbles. Immediately the workers on the outside of the nest examine the obstruction and then rush about as though they are searching for an opening. 5:02 P. M. — Several workers try to force an opening through the obstruction. 5:10 P. M. — One of the workers confined to the nest succeeds in forcing a passage-way to the outside. Immediately three workers begin to remove the pebbles. Up until now, no particle has been removed from the outside of the nest. 5:15 P. M. — Another worker emerges from within. 5:20 P. M. — The opening has been cleared, and the ants are busy bringing

from the nest the pebbles that the ants working from within the nest had carried inward from the obstruction.

Whether a nest contains several openings or only one, early in the morning and at night the openings are found to be closed. In the spring and early summer, I have often found all of the nest openings closed as late as 7:50 A. M. Careful observations, extending over a period of five months, demonstrated that the nest opening or openings are regularly closed, by the ants, at the close of day. The time required to complete the closing and the number of ants employed varies in different nests and in the same nest at different times; but the method in all cases is so similar that the following description of the behavior of the ants on one occasion will serve as a type of all.

It was eighteen minutes to seven, July 20, 1908, and darkness was fast approaching. Four workers were busy covering the nest opening with plant débris, sand and pebbles. Part of the time they would stand balanced upon the two posterior pairs of legs, with their heads turned away from the nest, and kick the sand backwards with their fore feet; and part of the time they would carry coarser materials and place them upon the nest. By twenty-three minutes after seven, the opening was almost closed and the ants passed inside. In a few minutes, two workers returned to the outside and continued the closing of the opening. Soon they were joined by a third worker. By forty minutes after seven the opening was closed; then the three workers wedged themselves inward through the closed entrance. Soon a worker returned to the outside and added more material to the pile over the nest opening. Then it forced its way into the nest. This behavior was repeated several times. The nest was finally closed from within. By eight o'clock everything was quiet.

On one occasion, I noticed this ant make use of this hole-closing instinct to rid itself of the encroachments of another ant. A species of *Atta* had constructed a burrow within the confines of a mound of a colony of *Pogonomyrmex badius*. When I first discovered these conditions, a single worker of the latter species was busy covering the opening of the burrow of *Atta* with sand. The sand was driven into the opening by the ant standing on its four hind legs and kicking the sand backward with its fore feet.

The larger particles were carried in the mouth and deposited therein. Every few moments the ant would enter the burrow and compact the sand with its head. Frequently it would leave the hole and wander about for a few moments. It always soon returned to the covering. After the hole had been filled to the level of the ground, the ant continued to pile on sand. When I left, at 10:03 A. M., the ant was still piling on sand. At no time was it assisted by any other ant, although numerous ants passed by it.

With few exceptions, on each mound there is one or more trash piles. In over two hundred mounds examined I noticed only one

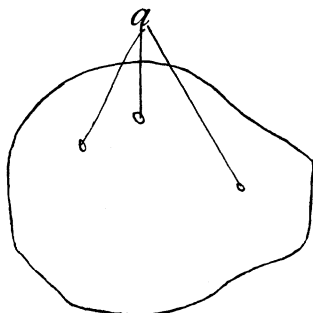


FIG. 3.

FIG. 3. Mound of *P. badius*. *a*, entrances. The mound is covered with pebbles, and dead stalks of grass and weeds are scattered over it. Greatest length, 32 in.; greatest width, 25 in.; greatest height, 5 in.

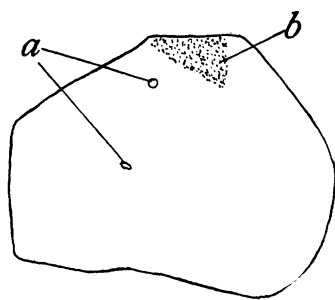


FIG. 4.

FIG. 4. Mound of *P. badius*, surface view. *a*, entrances; *b*, débris, mostly plant matter, from the nest. The mound is covered with pebbles. On the outer edge there are a few stalks of grass. At one time this mound had four openings. Greatest length, 32 in.; greatest width, 27 in.

exception (Fig. 3). On this trash pile is dumped débris from the nest, supplemented by plant material obtained in the surrounding territory. The major portion of the pile is composed of plant matter, the remainder of remnants of insects. In some cases the trash-pile surrounds the nest-opening (Figs. 1, 5, 7, 8); but in most cases it does not seem to bear any definite relation to that opening (Figs. 2, 4, 6).

It seems self-evident that a mound as conspicuous as this must play some important rôle in either the present or the past behavior of the species. It is possible that it serves more than one pur-

pose ; however, several months careful study has convinced me that one of the most important functions of this mound is to serve as a device to promote sexual union. The following description of the behavior of this species, during the process of mating, will make this point clear.

Mating takes place, at intervals, during the warm weather. How often this occurs and whether the intervals are regular or irregular I am not prepared to say. I observed the inmates of one set of nests mate on June 8 and again on June 16, and, on several other occasions, I saw what looked like signs of recent mating. Practically all the nests of the same locality mate at the same time. On one mating occasion, out of eleven nests occurring within a radius of a few yards, the inmates of eight were going through the mating behavior. The three colonies that were not mating were small and weak.

During the daylight hours, a few workers usually promenade on top of the mound ; just before a mating is to occur, this number is increased many fold. To a casual observer, it looks as though the majority of the inmates of the nest were out for a sun bath. All move about in a nervous manner. A few males and a few unfertilized (winged) females repeatedly emerge from the nest, move about for a few moments, and then retire. After this has continued for a time, the males fly away and the females promenade among the restless workers. When the males arrive at another mound, they alight and move about, in a jerky, nervous manner, among the restless workers and females on the mound. If, in its zigzag rushing, the male comes in contact with one or more workers, these neuters attack it at once. Sometimes a male attempts to enter the nest. It is at once opposed by the workers. I have never seen a male succeed in entering the nest ; but, I think they do sometimes ; for, on more than one occasion, I have seen workers dragging males out of the nest. When a male comes in contact with a winged female, he mounts her back and attaches his reproductive organs to the tip of her abdomen. She either remains quiet, or else, gently nibbles the abdomen of the male with her jaws. After a few minutes of intimate contact, the ants separate ; each to repeat the act with some other ant. This coition always occurs either on the ground or on a blade of grass or a low weed ; never in the air.

That the same female accepts the attentions of several males and that the same male serves several females I have established by experiments conducted as follows: A number of males, captured as soon as they alighted on the mound, were confined, by means of cotton plugs, in a small test-tube. In a second test-tube, was placed a single female. Into this second tube a single male was introduced. As soon as the pair had separated after coition, that male was removed and a fresh male introduced. This was repeated until the female refused to mate. A dozen experiments of this sort were conducted. The greatest number of males

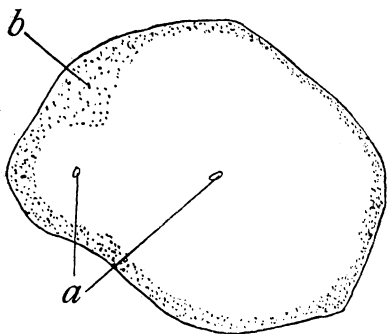


FIG. 5.

FIG. 5. Mound of *P. badius*, surface view. *a*, entrances; *b*, débris, mostly plant matter, from the nest. There is a depression around the main opening. Greatest length, 38 in.; greatest width, 31 in.

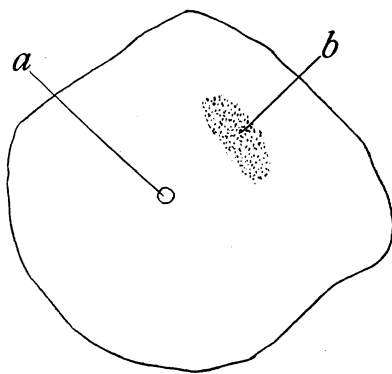


FIG. 6.

FIG. 6. Mound of *P. badius*, surface view. *a*, entrance; *b*, débris, mostly plant matter, from the nest. Scattered over the top of the nest, are numerous pebbles and bits of coal. Near the opening there is a depression which slopes towards the opening. Near the edge there are a few stalks of grass. Greatest length, 39 in.; greatest width, 34 in.

accepted by the same female was four; the least number was two. After the last successful coition, the introduced male always tried to copulate, but in vain. On the mound, on several different occasions, I have seen the same female copulate with two different males.

In another series of a dozen experiments, several females were removed from the top of the mound and confined in a cotton-stoppered test-tube. In another tube was confined a male that had just arrived at the mound. One of the females was intro-

duced into the tube with the male. They copulated immediately. As soon as coition was over, the female was removed and a fresh female introduced. This was repeated until the male would no longer mate. The greatest number of females served by the same male was five; the least, four. After the last successful coition, when a fresh female was added, the male would attempt to copulate, but in vain.

These experiments show, conclusively, that the same female may mate with several different males and that the same male may serve several females. As to the number of services that either may give or accept, these experiments do not give a final

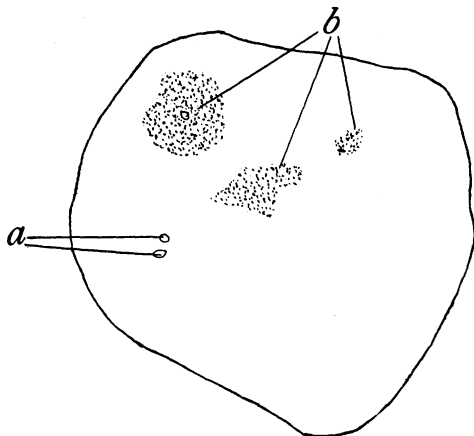


FIG. 7. Mound of *P. badius*, surface view. *a*, entrances; *b*, débris, mostly plant matter, from the nest. The top is covered with pebbles. On the edge there are a few stalks of grass. Greatest length, 40 in.; greatest width, 39 in.

answer; for there was no way of being sure that the female captured on the nest had not previously been served; nor could I be absolutely certain that the male had not visited some other mound and copulated before arriving at the nest.

From the above description, it seems evident that the mound of this species is a device for promoting cross-fertilization. The large, conspicuous, expanse of barren land in the midst of vegetation serves as a stimulus to attract the flying male. Whether this is to be regarded as a tropism or an ordinary reflex is more than the experiments answer. That it is an instinctive response is self-evident.

There is a wide-spread belief that the male ant always dies within a few hours after copulation. The following two experiments show that, in this species, the male may live for several days after mating.

June 8, 1908. — Five males, captured just after copulation, are confined to a Janet nest. June 10. — All are alive. June 11. — Two are dead and three living. June 12. — Three are dead and two living. June 16. — Four are dead and one is dying.

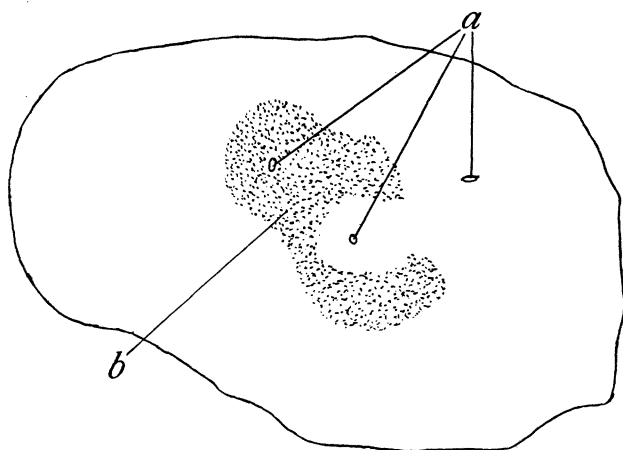


FIG. 8. Mound of *P. badius*, surface view. *a*, entrances; *b*, débris, mostly plant matter, from the nest. The surface is covered with pebbles and bits of coal. Near the edge a few grass stalks are growing, and, scattered over the surface, a few stalks of dead grass are standing. Greatest length, 60 in.; greatest width, 42 in.

June 16, 1908. — Fifteen males, captured just after copulation, are confined in a Janet nest. June 17. — All are alive. June 18. — All are alive. June 19. — One is dead, one is dying, and thirteen are alive. This series was interrupted by a forced absence from the laboratory.

In each of the above cases no male died until at least two days had elapsed after copulation, and, in each case, some of the males lived for several days.

Females captured immediately after copulation and confined in a Janet nest, often did not shed their wings until at least two days had elapsed. This is not in harmony with the belief that all female ants shed their wings on the evening of the day on which copulation occurs.

CONCLUSIONS.

1. At the mating time, the females of *Pogonomyrmex badius* and the numerous workers roam about on their home mound; but the males fly away.

2. The broad, barren mound, situated in the midst of vegetation, arrests the males in their flight and thus promotes cross-fertilization.

3. Mating occurs on the ground or on a blade of grass or on a small, low weed; but never on the wing. This usually happens on the mound; but, sometimes, it occurs in the adjacent grass.

4. The same female may be impregnated by several males, and the same male may serve several females.

5. The male does not die until several days after mating.

6. The nest openings are closed by the ants at the close of every day.

SUMMER HIGH SCHOOL,

ST. LOUIS, MO.,

April 9, 1909.